

Claims

1. Ceramic cutting tool with an improved resistance to wear of the edge area or edge layer, characterized in that the cutting tool is a multiphase ceramic (starting ceramic) which is made of a base ceramic and a sacrificial phase as well as eventually additives and primary hard material phases and an eventually multilayered edge area or edge layer resistant to wear, hard, not precipitated, made of at least one hard material phase, whereby the edge area is intimately intergrown with the starting ceramic and which is formed by aging the starting ceramic in a defined atmosphere.
2. Cutting tool according to claim 1, characterized in that the starting ceramic consists of a sacrificial phase with 50% by volume at the most and eventually additives with 40% by volume at the most and eventually a primary hard material phase with 50% by volume at the most, the rest base ceramic.
3. Cutting tool according to any of the claims 1 and 2, characterized in that the base ceramic consists of Al_2O_3 .
4. Cutting tool according to any of the claims 1 to 3, characterized in that the sacrificial phase consists of the oxyde and/or an oxygen containing compound of carbon and/or nitrogen and/or boron, of one or several characteristic elements,

especially of titanium oxyde and/or titanium oxycarbide and/or titanium oxynitride and/or titanium oxycarbonitride.

5. Cutting tool according to any of the claims 1 to 4, characterized in the characteristic elements are elements of the 3rd or the 4th or the 5th period, of the subsidiary group IV or V or VI of the system of the period of the elements and/or boron and/or silicium, preferably titanium and/or zirconium and/or vanadium and/or tungstene and/or boron and/or silicium, especially titanium and/or zirconium.
6. Cutting tool according to any of the claims 1 to 5, characterized in that zirconium oxyde is used as additive.
7. Cutting tool according to any of the claims 1 to 6, characterized in that the primary hard material phase is the carbide and/or nitride and/or boride and/or carbonitride and/or carboboride and/or boron nitride and/or carboboron nitride of one or of several characteristic elements, preferably titanium carbide and/or titanium carbonitride, especially titanium carbide.
8. Cutting tool according to any of the claims 1 to 7, characterized in that the edge area or edge layer consists mainly of carbides and/or nitrides and/or borides and/or the mixtures thereof of one or of several characteristic elements and has a thickness between 0,1 μm and 20 μm , preferably between 0,5 μm and 8 μm , especially between 1 μm and 4 μm .
9. Cutting tool according to any of the claims 1 to 8,

characterized in

that a junction area of between 50 nm and 5 μm is formed between the edge area and the starting material, junction area in which they are intimately intergrown.

10. Cutting tool according to any of the claims 1 to 9,
characterized in
that the structure of the multiphase ceramic has a mean grain size between 100 nm and 10 μm , preferably between 300 nm and 5 μm , in particular between 500 nm and 3 μm .
11. Cutting tool according to any of the claims 1 to 10,
characterized in
that the sacrificial phase consists of titanium oxycarbide and has a lower nanohardness than Al_2O_3 (measured with Berkovichindenter, at 3 mN), at the most 26 GPa, preferably 23 GPa.
12. Cutting tool according to any of the claims 1 to 11,
characterized in
that the edge area or edge layer mainly consists in particular of titanium carbide which has a higher nanohardness than Al_2O_3 (measured with Berkovichindenter, at 3 mN), preferably in the range between 27 GPa and 35 GPa, in particular 29 GPa to 32 GPa.
13. Cutting tool according to any of the claims 1 to 12,
characterized in
that an one-layer or multilayer coating is applied onto the edge area or edge area by means of physical and/or chemical precipitation of the same and/or of different materials, whereby the service properties of the cutting tool are improved.

14. Method for manufacturing a cutting tool with an improved resistance to wear of the edge area or edge layer according to any of the claims 1 to 13,
characterized in
that the method comprises the following steps:
 - According to known powder metallurgical methods, the starting powders are processed, green bodies manufactured and compacted to semifinished products with known sintering methods;
 - Manufacturing of the wished cutting edge geometry, preferably by grinding, in particular of the first face, free face and protection chamfer;
 - Production of edge areas or edge layers after the hard machining of the cutting tool by subsequent aging in a defined atmosphere.
15. Method for manufacturing a cutting tool with an improved resistance to wear of the edge area or edge layer according to any of the claims 1 to 13,
characterized in
that the method comprises the following steps:
 - According to known powder metallurgical methods, the starting powders are processed, green bodies manufactured and compacted to semifinished products with known sintering methods;
 - Manufacturing of the wished cutting edge geometry, preferably by grinding, in particular of the first face, free face and protection chamfer;

- Production of edge areas or edge layers after the hard machining of the cutting tol by subsequent aging in a defined atmosphere.

16. Method for manufacturing a cutting tool with an improved resistance to wear of the edge area or edge layer according to any of the claims 1 to 13,
characterized in
a multiphase starting ceramic/starting material is made available which consists of a a sacrificial phase of at the most 50% by volume and at the most 40% by volume additives and at the most 50% by volume primary hard material phase and the rest base ceramic, whereby

- after the powder processing a green body manufacturing takes place with a subsequent reaction sintering,
- then a hard machining of the sintered ceramic body, preferably by grinding, in particular of the first face, protection chamfer and free face, is carried out and
- after the hard machining of the ceramic cutting body a thermal, preferably thermally pressure-assisted aging in a reducing, preferably in a carbon and/or nitrogen containing atmosphere, specially a high-pressure isostatic pressing, preferably at 1550°-1650 °C or at other appropriate temperatures for producing an edge area or edge layer on a multiphase, preferably on Al_2O_3 based ceramic.

17. Method for manufacturing a cutting tool with an improved resistance to wear of the edge area or edge layer according to any of the claims 1 to 13,
characterized in
that the method comprises the following steps:

- After the known powder metallurgical methods, the starting powder is processed and green bodies are manufactured; preferably the composition of the starting powders is chosen with respect to a reaction sintering, in particular with respect to an aluminothermic reaction sintering;
- Presintering of the green body preferably below the foreseen maximal sintering temperature, preferably in the temperature range of 200° and 1500 °C, in particular 300 and 800 °C, preferably at a pressure between 0,001 mbar and 1bar, in particular between 0,01 mbar and 100 mbar, preferably by using a rinsing gas, in particular argon, preferably in a defined atmosphere, preferably in a reducing, in particular in a carbon containing atmosphere.
- Machining of the presintered cutting body for manufacturing the wished cutting edge geometry, preferably by grinding, in particular of the free face and/or the protection chamfer and/or the first face;
- Second sintering or dense sintering of the presintered and hard machined semifinished product with simultaneous or subsequent aging in a defined atmosphere for producing an edge area or edge layer.

18. Method according to any of the claims 14 to 17,
characterized in
that the sintering or presintering and/or the second sintering of
the ceramic cutting body takes place by means of
aluminothermic or reactive or conventional depressurized,
eventually vacuum-assisted sintering and/or by means of high-
temperature isostatic pressing and/or hot pressing and/or
microwave sintering and/or laser sintering.

19. Method according to any of the claims 14 to 18,
characterized in
that the edge are is formed by thermal, eventually pressure-assisted aging (or sintering according to claim 17) of the cutting body.
20. Method according to any of the claims 14 to 19,
characterized in
that the edge area is formed by aging in a defined, preferably reducing, in particular in a carbon containing atmosphere, preferably in a furnace with carbon or carbon containing heating elements.
21. Method according to any of the claims 14 to 20,
characterized in
that the edge area is formed by aging in a defined, preferably reducing, in particular in a carbon containing atmosphere, in particular in a nitrogen containing atmosphere.
22. Method according to any of the claims 14 to 21,
characterized in
the edge area is formed by aging at maximal temperatures between 1000 °C and 2500 °C, preferably between 1300 °C and 2000 °C, in particular between 1550° and 1650 °C.
23. Method according to any of the claims 14 to 22,
characterized in
that the edge area is formed by thermal or thermally pressure-assisted aging at a pressure of between 0,001 mbar and 4000 bar, preferably at a pressure between 100 bar and 3000 bar.
24. Method according to any of the claims 14 to 23,
characterized in

the edge area is formed by aging by using rinsing and/or pressure gas, preferably argon and/or nitrogen, in particular argon.

25. Method according to any of the claims 14 to 24,
characterized in

the edge area is formed by aging at stay-down times between 1 min and 300 min, preferably between 5 min and 180 min, in particular between 10 min and 60 min, at a pressure chose according to claim 23 and/or at a temperature chosen according to claim 22.

26. Method according to any of the claims 14 to 25,
characterized in

that the aging takes place in a sintering bed, preferably in a carbon containing sintering bed.

27. Method according to any of the claims 14 to 26,
characterized in

that due to the aging an externally discoloured edge area, preferably an at the surface gold yellow edge area is produced.

28. Use of a ceramic cutting tool with an improved resistance to wear of the edge area or edge layer produced by aging of the ceramic starting material as part according to any of the claims 1 to 13 in apparatus and mechanical engineering, in particular as cutting body, which is used for the machining of metallic materials with a hardness higher than 50 HRC, preferably of hardened steel or materials for casting, whereby the cutting body has a first face and a free face and an cutting edge formed at the junction of the first face and of the free face which is preferably chamfered (protection chamfer).